Tierra Solutions, Inc.

Quality Assurance Project Plan for River Mile 10.9 Pipeline Surveys:
Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar

June 2014

Revision 2

Prepared By:

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University of Illinois
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Prepared For:

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616236

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Acronyms and Abbreviations

CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CPG	Cooperating Parties Group
DQO	data quality objectives
FGDC	Federal Geographic Data Committee
FRS	Field Research Specialist
FSP	Field Sampling Plan
ft	feet/foot
GPS	Global Positioning System
GPR	Ground Penetrating RADAR
HASP	Health and Safety Plan
HAZWOPER	Hazardous Waste Operations and Emergency Response
in	inch
LPRSA	Lower Passaic River Study Area
m	meter
mm	millimeter
N/A	not applicable
NGVD29	National Geodetic Vertical Datum of 1929
PES	Parametric Echosounder
PM	Project Manager
PQO	project quality objectives
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RIWP	Remedial Investigation Work Plan
RPM	Remedial Project Manager
RTK	Real Time Kinematic
SE	southeastern
SOP	Standard Operating Procedure
SSO	Site Safety Officer
TBD	to be determined
Tierra	Tierra Solutions, Inc.
UAO	Unilateral Administrative Order
UFP	Uniform Federal Policy

UoI	University of Illinois – Department of Geology
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

1. Introduction

This Quality Assurance Project Plan (QAPP) has been prepared at the request of the U.S. Environmental Protection Agency (USEPA) to identify the horizontal and vertical location of two 72-inch diameter water pipelines crossing the Passaic River near River Mile 10.9 (RM 10.9) of the Passaic River. The objective of locating these two pipelines will be accomplished by surveying the river and adjacent shoreline using, respectively, a Parametric Echosounder (PES) and Ground-penetrating RADAR (GPR). The work completed as part of this QAPP will be performed under the requirements of the Unilateral Administrative Order (Comprehensive Environmental Response Compensation and Liability Act [CERCLA] -02-2012-2020 (United States Environmental Protection Agency [USEPA] 2012) for RM 10.9 of the Lower Passaic River Study Area (LPRSA), with oversight conducted by the USEPA.

This plan describes the implementation of the field data collection, data analysis, and associated quality assurance (QA) and quality control (QC) activities developed for this program.

This document uses applicable worksheets from the Uniform Federal Policy (UFP) on QAPPs [Publication Numbers: EPA: EPA-505-B-04-900A Department of Defense: DTIC ADA 427785] (USEPA 2005) and activity-specific Standard Operating Procedures (SOPs) for the field activities.

1.1 Background Information

The RM 10.9 Study Area is an area that was subject to a focused characterization and removal action (sediment removal and capping) by the LPRSA Cooperating Parties Group (CPG) in response to the finding of elevated concentrations of chemicals of potential concern (COPCs) in the surface sediments. Work was initiated in 2013 and is expected to be completed in mid-2014. The RM 10.9 Study Area extends bank-to-bank between RM 10 and RM 12 of the LPRSA (Figure 1). The RM 10.9 Removal Area (the area subject to CPG's removal action) is an approximately 5.6-acre area located along an inside bend on the southern and eastern shore of the Passaic River upstream of the DeJessa Park Avenue Bridge. The area includes the mudflat and point bar in the southern/eastern half of the river channel. It is bounded to the west by the navigation channel of the Passaic River and to the east by the Riverside Park complex, which is owned and operated by Bergen County and the Town of Lyndhurst.

The two 72-inch diameter water pipelines bifurcate the RM 10.9 Removal Area. Because the exact horizontal and vertical locations of these pipes were not identified by the CPG prior to their remedial work, a No Dredge Zone in the area of the pipelines was established so as to not potentially damage the pipes during the CPG's remedial efforts (refer to Figure 1.)

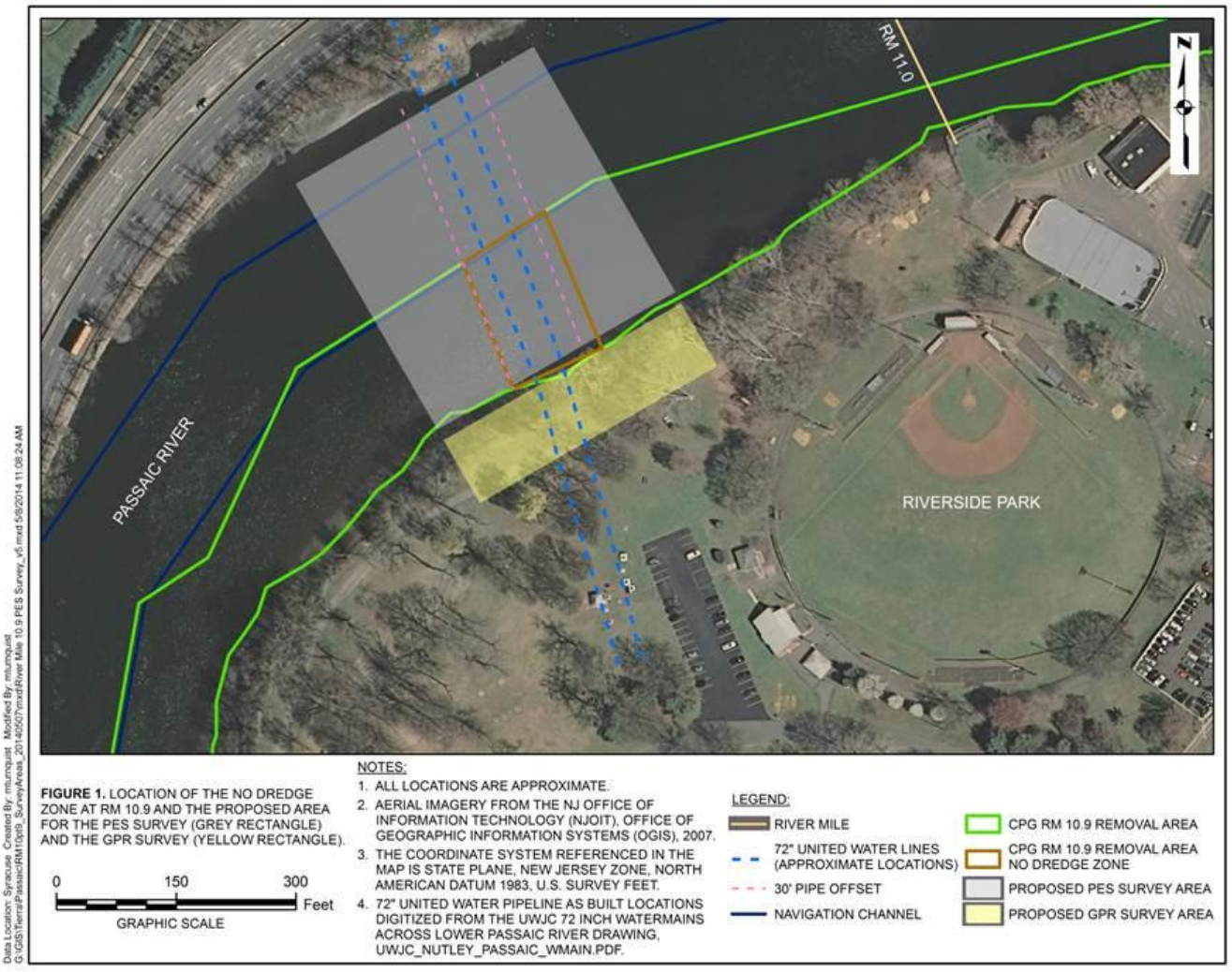

FIGURE 1. LOCATION OF THE NO DREDGE ZONE AT RM 10.9 AND THE PROPOSED AREA FOR THE PES SURVEY (GREY RECTANGLE) AND THE GPR SURVEY (YELLOW RECTANGLE).

Section 2.
QAPP Worksheets

QAPP Worksheet #1 (UFP-QAPP Manual Section 2.1) Title and Approval Page
Document Title: Quality Assurance Project Plan for RM 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar

Lead Organization:

Tierra Solutions, Inc.
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East Brunswick, New Jersey 08816
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E-mail: paul.brzozowski@tierra-inc.com

Preparer's Name and Organizational Affiliation:

Mr. Clifford Firstenberg, Tierra Solutions, Inc.

and

Dr. Jim Best, University of Illinois- Department of Geology

Preparer's Address, Telephone Number, and E-mail Address:

Two Tower Center Boulevard, Tenth Floor
East Brunswick, NJ 08816

Phone: 757-258-7720
Email: Clifford.Firstenberg@tierra-inc.com

and

605 E Springfield Ave
Champaign, Il 61820

Phone: 217-244-1839
Email: jimbest@illinois.edu

Preparation Date (Month/Day/Year): June 13, 2014

Investigative Organization's Project Manager	Dr. James Best/ University of Illinois
Investigative Organization's Project QA Manager	Dr. James Best/ University of Illinois
Lead Organization's Project Coordinator	Paul S. Brzozowski/ Tierra

QAPP Worksheet #2 (UFP-QAPP Manual Section 2.2.4) QAPP Identifying Information

Site Name/Project Name:	RM 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar
Site Location:	Passaic River, New Jersey
Site Number/Code:	CERCLA Document No. 02-2012-2020
Operable Unit:	00
Contractor Name:	University of Illinois
Contractor Number:	Not Applicable (N/A)
Contract Title:	N/A
Work Assignment Number:	N/A

1. Identify guidance used to prepare QAPP:

   - USEPA. 2005. U.S. Department of Defense, and U.S. Department of Energy. Intergovernmental Data Quality Task Force. Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. USEPA 505-B-04-900A.Final Version 1. March.

2. Identify regulatory program: CERCLA.

3. Identify approval entity: USEPA Region 2

4. Indicate whether the QAPP is a generic or a project-specific QAPP. (circle one)

5. List dates of scoping sessions that were held:

   - 21 February 2014, River Mile 10.9 Pipeline Survey 10.9: Statement of Work

6. List dates and titles of QAPP and Field Sampling Plan (FSP) documents written for previous site work, if applicable:

7. List organizational partners (stakeholders) and connection with lead organization:

   This work will be performed under the requirements of the Unilateral Administrative Order (CERCLA-02-2012-2020) (USEPA 2012) for RM 10.9 of the

LPRSA, with oversight conducted by USEPA. Tierra (Mr. Paul Brzozowski acting as Project Coordinator), has engaged UoI to conduct the work on its behalf.

8. List data users: See item #7 above.

9. If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below:

   The planned PES and GPR surveys described in this QAPP involve the collection of field-measured electronic data only (vessel position, properties of the water mass [temperature and conductivity], sub-surface depths, and x, y and z co-ordinates of the pipelines). As such, a number of worksheets are not considered applicable to this investigation and are not included in this document.

   No laboratory analyses are required as part of this investigation, and therefore, the following worksheets are not applicable to this effort:

   #15 Data Quality Levels and Analytical Method Evaluation

   #19 Analytical SOP Requirements Table

   #23 Analytical SOP References Table

   #24 Analytical Instrument Calibration Table

   #25 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

   #30 Analytical Services Table

   #36 Validation (Steps IIa and IIb) Summary Table

   No physical samples will be collected as part of this investigation, and therefore, the following worksheets are not applicable to this effort:

   #20 Field Quality Control Sample Summary Table

   #26 Sample Handling System

#28 QC Samples Tables

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information Relevant to Collection of PES and GPR Data	Crosswalk to QAPP Worksheet No. or Related Documents
Project Management and Objectives		
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2.5 Project Planning/Problem Definition 2.5.1 Project Planning (Scoping) 2.5.2 Problem Definition, Site History, and Background	- Project Planning Session Documentation (including Data Needs tables) - Project Scoping Session Participants Sheet - Problem Definition, Site History, and Background - Site Maps	9 9 10 5/Figure 1
2.6 Project Quality Objectives (PQOs) and Measurement Performance Criteria 2.6.1 Development of PQOs Using the Systematic Planning Process 2.6.2 Measurement Performance Criteria	- Site-Specific PQOs - Measurement Performance Criteria Table	11 12
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Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information Relevant to Collection of PES and GPR Data	Crosswalk to QAPP Worksheet No. or Related Documents
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3.2 Analytical Tasks 3.2.1 Analytical SOPs 3.2.2 Analytical Instrument Calibration Procedures 3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures 3.2.4 Analytical Supply Inspection and Acceptance Procedures		23, 24, 25 N/A
3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures	- Sample Custody Requirements	26 N/A 27
3.4 QC Samples 3.4.1 Sampling QC Samples 3.4.2 Analytical QC Samples		28 N/A
3.5 Data Management Tasks 3.5.1 Project Documentation and Records 3.5.2 Data Package Deliverables 3.5.3 Data Reporting Formats 3.5.4 Data Handling and Management 3.5.5 Data Tracking and Control	- Project Documents and Records Table - Data Management Procedures	 29 30 N/A Appendix A
Assessment/Oversight		
4.1 Assessments and Response Actions 4.1.1 Planned Assessments 4.1.2 Assessment Findings and Corrective Action Responses	- Planned Project Assessments Table - Assessment Findings and Corrective Action Responses	31 32
4.2 QA Management Reports	- QA Management Reports Table	33
4.3 Final Project Report	- To be completed following data collection	Not available

Required QAPP Element(s) and Corresponding QAPP Section(s)	Required Information Relevant to Collection of PES and GPR Data	Crosswalk to QAPP Worksheet No. or Related Documents
Data Review		
5.1 Overview 5.2 Data Review Steps 5.2.1 Step I: Verification 5.2.2 Step II: Validation 5.2.3 Step III: Usability Assessment	 - Verification (Step I) Process Table - Verification (Steps IIa and IIb) Process Table - Usability Assessment	 34 35 36 N/A 37
5.3 Streamlining Data Review 5.3.1 Data Review Steps To Be Streamlined 5.3.2 Criteria for Streamlining Data Review 5.3.3 Amounts and Types of Data Appropriate for Streamlining	- To be completed following data evaluation	Not available

QAPP Worksheet #3 (UFP-QAPP Manual Section 2.3.1) Distribution List

QAPP Recipients	Title	Organization	Telephone Number	E-mail Address	Document Control Number
Jennifer LaPoma	Remedial Project Manager (RPM)	USEPA Region 2	212.637.4328	LaPoma.Jennifer@epamail.epa.gov	N/A
Stephanie Vaughn	RPM	USEPA Region 2	212.637.3914	Vaughn.Stephanie@epa.gov	N/A
Ray Basso	Strategic Integration Manager	USEPA Region 2	212.637.4417	basso.ray@epamail.epa.gov	N/A
Sarah Flanagan	Attorney	USEPA Region 2	212.637.3136	Flanagan.Sarah@epamail.epa.gov	N/A
Derrick Vallance	Assistant General Counsel	Maxus Energy	281.681.7255	dvallance@maxuscorp.com	N/A
Carol Dinkins	Attorney	Vinson & Elkins	713.758.2528	cdinkins@velaw.com	N/A
Paul S Brzozowski	Project Coordinator	Tierra	732.246.5851	paul.brzozowski@tierra-inc.com	N/A
Clifford Firstenberg	Environmental Sciences Manager	Tierra	757.258.7720	Clifford.Firstenberg@tierra-inc.com	N/A
Michael Reed	Field Research Specialist (FRS) and Site Safety Officer (SSO)	UoI	217.244.8002	mjreed@illinois.edu	N/A
James Best	Pipeline Survey Manager	UoI	217.244.1839	jimbest@illinois.edu	N/A
Jessica Zinger	Field Technician	UoI	217.372.4514	zinger1@illinois.edu	N/A
Greg Smith	GPR task lead	University of Birmingham	+44(0)1214158023	g.smith.4@bham.ac.uk	N/A
Other project team members and stakeholders					N/A

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization: A completed sign-off sheet will be maintained in the files for each organization shown below. A blank form is provided on the following page.

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read
Paul Brzozowski	Project Coordinator (Tierra)	732.246.5851		
Clifford Firstenberg	Environmental Sciences Manager (Tierra)	757.258.7720		
Jim Best	Survey Manager (UoI)	217.244.1839		
Michael Reed	FRS/SSO (UoI)	217.244.8002		
Jessica Zinger	Field Technician	217.372.4514		
Greg Sambrook Smith	GPR task lead	+44(0)1214158023		

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

QAPP Worksheet #4 (UFP-QAPP Manual Section 2.3.2) Project Personnel Sign-Off Sheet

Organization:

Project Personnel	Title	Telephone Number	Signature*	Date QAPP Read

*Signature indicates that personnel have read the applicable QAPP sections and will perform the tasks as described.

QAPP Worksheet #5 (UFP-QAPP Manual Section 2.4.1) Project Organizational Chart

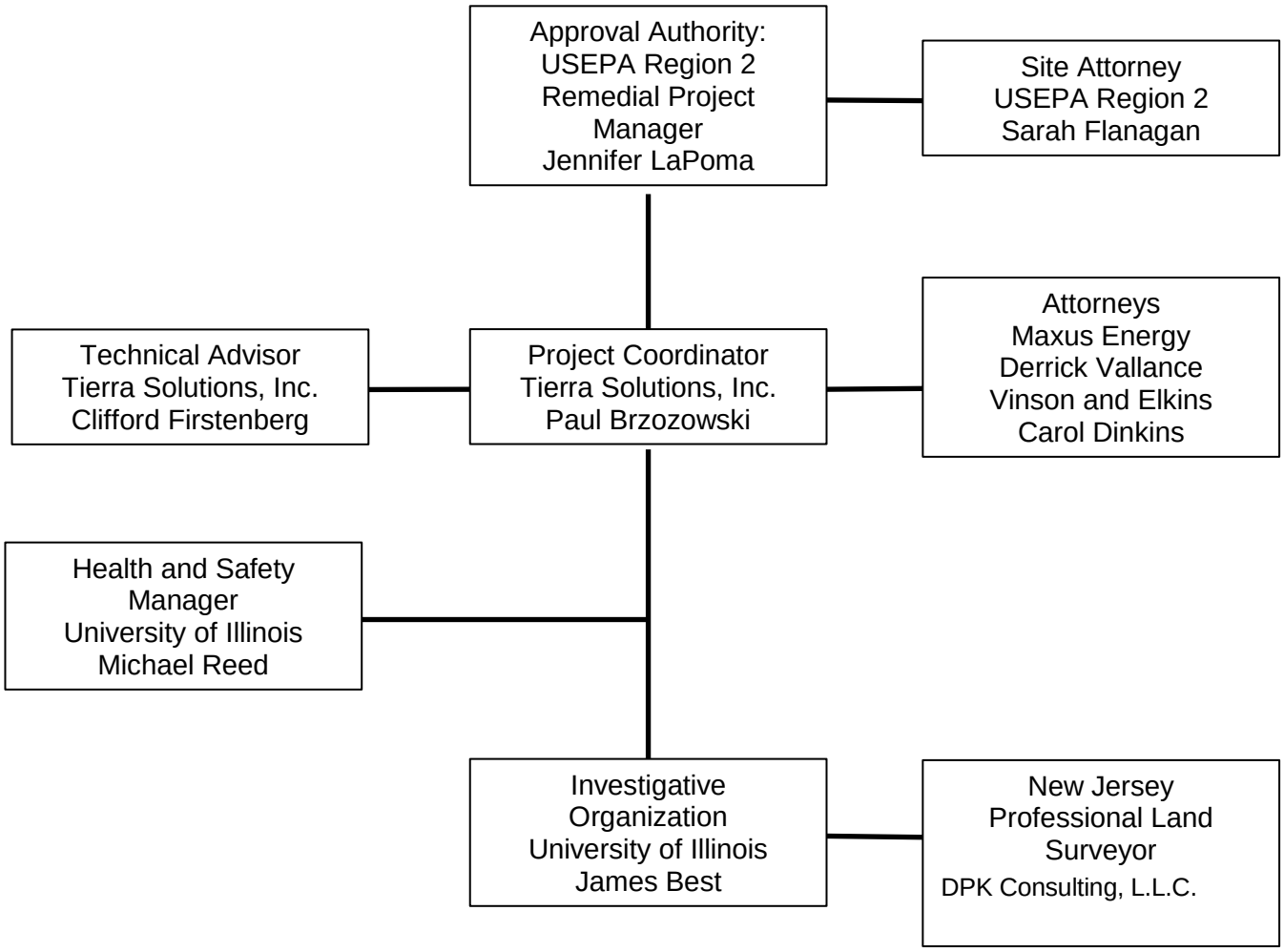

***Figure 2**. Organization chart for the RM 10.9 Survey; Geophysical Surveys.*

QAPP Worksheet #6 (UFP-QAPP Manual Section 2.42) Communication Pathways

Communication Drivers	Responsible Entity	Name	Phone Number (mobile)	Procedure (timing, pathways, etc.)
Field activities status and issues	Survey Field Task Lead	Jim Best	217.778.6359	Communicate daily with Project Coordinator via e-mail or phone.
	Tierra Project Coordinator	Paul Brzozowski	732.246.5851	Communicate daily, or as needed, with USEPA regarding status updates and deviations and/or proposed revisions received from UoI Survey Field Task Lead. Any revisions to procedures will be discussed with USEPA and oral approval received prior to implementation; written revisions will also be submitted to USEPA.
Field and data processing analysis	UoI Survey Field Task Lead	Jim Best	217.778.6359	Communicate daily with Project Coordinator via e-mail or phone.
Health and safety briefings and updates	SSO	Michael Reed	312.420.9139	Communicate daily, or as needed, with field personnel and boat operators directly, or via e-mail or phone.
Significant health and safety concerns or incidents	SSO	Michael Reed	312.420.9139	Communicate immediately with Project Team and Project Health and Safety Manager in accordance with the Health and Safety Plan (HASP).
Survey vessel operations	Survey Field Task Lead	Jim Best	217.778.6359	Communicate daily, or as needed, with Project Coordinator.
Audit findings (field and/or data processing)	Tierra	TBD	TBD	Communicate findings to Project Coordinator; transmit final audit reports, including corrective actions, to Project Team.
Issues potentially affecting data quality objectives (DQOs)	UoI	Jim Best	217.778.6359	Communicate with Project Coordinator, via e-mail or phone. Significant work plan modifications will be proposed to the Project Coordinator.

Communication Drivers	Responsible Entity	Name	Phone Number (mobile)	Procedure (timing, pathways, etc.)
Project status and issues (internal)	UoI	Jim Best	217.778.6359	Communicate with Project Coordinator daily, or as needed, via email or phone, and submit monthly progress reports.
Project status and issues (external)	Tierra Project Coordinator	Paul Brzozowski	908.328.8395	Communicate with USEPA and UoI as needed via e-mail or phone.
Data management	UoI	Jim Best	217.778.6359	Communicate with the Project Coordinator via email; transmit final processed and supporting data files.
Stop Work (technical non-compliance)	Project Team	N/A	N/A	Any person believing that stopping work is necessary shall first verbally notify their respective PM, who will, in turn, verbally notify the Project Coordinator, if necessary. Given the potential significance of such communications, this should occur as quickly as possible.

QAPP Worksheet #7 (UFP-QAPP Manual Section 2.4.3) Personnel Responsibilities and Qualifications Table

Name	Title	Organizational Affiliation	Responsibilities	Education and Experience Qualifications[1]
Paul Brzozowski	Tierra Project Coordinator	Tierra	Overall responsibility for the safe and proper execution of task. Be available to discuss and review technical and other issues that may arise during work. Periodically review and audit work to ensure that work plan, project QA/QC, health and safety including both boating and hazardous materials worker safety procedures are being followed. All deviations from approved project plans will be discussed with and approved by the Project Coordinator. Primary point of contact with the USEPA and its oversight contractor.	B.S. Civil Engineering; 32) years' experience
Clifford Firstenberg	Technical Advisor	Tierra	Provide technical advice on the environmental conditions of the Passaic River and the application of the planned remotes sensing technologies consistent with this UFP QAPP.	B.A. Earth and Planetary Sciences M.S. Marine Environmental Sciences/Physical Oceanography; 32 years' experience
Jim Best	Survey Field Task Lead	UoI	Responsible for safe and accurate implementation of the field data collection and post-survey data processing and quality.	B.Sc. geology/ geography Ph.D. Geology 33 years' experience
Michael Reed	Project Health and Safety Manager	UoI	Responsible for developing the project-specific HASP and for ensuring adherence to the HASP by field personnel.	B.S. Geology focus in Marine Geology 6 years' experience
Michael Reed	Site Safety Officer	UoI	Responsible for ensuring that the implementations of all HASP protocols are met on a daily basis; responsible for communicating all reportable incidents to the Project Coordinator.	B.S. Geology focus in Marine Geology 6 years' experience
Greg Sambrook Smith	GPR Task Lead	University of Birmingham	Perform GPR task.	B.Sc. in Geography Ph.D. in Geography 20 years' experience
Jessica Zinger	Field Technician	UoI	Perform field tasks as directed.	B.S. Physics M.S. Physical Geography 5 years' experience

[1] Resumes of all individuals are available upon request.

QAPP Worksheet #8 (UFP-QAPP Manual Section 2.4.4) Special Personnel Training Requirements Table

Workers on the boat will be HAZWOPER certified, either 40-hour or 24-hour, depending upon their potential annual exposure.

Workers performing the GPR survey may not be HAZWOPER certified since they will not be doing any invasive work and will not be doing any work on the mudflat. Further, it would be inconsistent to require workers in an area freely used by the public to be required to have HAZWOPER training..

Additional health and safety information is detailed in the site-specific Health and Safety Plan.

While there is no specific training required to properly operate these systems, personnel using the remote-sensing and positioning instruments have extensive past experience with this equipment. Curricula vitae demonstrating experience using these systems will be provided.

QAPP Worksheet #9 (UFP-QAPP Manual Section 2.5.1) Project Scoping Session Participants Sheet

Project Name: PES and GPR Survey **Projected Date(s) of Sampling:** Spring/early Summer 2014 **Project Manager:** Paul Brzozowski	**Site Name :** RM 10.9 **Site Location :** Passaic River, New Jersey
Date of Session: March 3, 2014 – Submittal of Statement of Work (SOW) for Pipeline Survey **Scoping Session Purpose:** Development of scope for pipeline survey.	

Name	Affiliation	E-mail Address	Project Role
Sarah Flanagan	USEPA	flanagan.sarah@epa.gov	USEPA Attorney
Ray Basso	USEPA	basso.ray@epa.gov	USEPA Manager
Stephanie Vaughn	USEPA	vaughn.stephanie@epa.gov	USEPA RPM
Patricia Hick	USEPA	hick.patricia@epa.gov	USEPA Attorney
Carol Dinkins	Vinson&Elkins	cdinkins@velaw.com	Attorney for Respondent
Derrick Vallance	Maxus Energy	dvallance@maxuscorp.com	Attorney for Respondent
Jim Best	Univ. of Illinois	jimbest@illinois.edu	Survey Lead
Paul Bluestein	Tierra Solutions	pjbluestein@tierra-inc.com	prior Project Coordinator

Comments/Decisions: Respondents submitted an SOW to USEPA on March 3, 2014 to perform a study to investigate the location of the water mains at the River Mile 10.9 Removal Action Area. Respondents received from USEPA conditional approval of the SOW on April 3, 2014 and submitted a revised SOW for final approval on April 18, 2014.

QAPP Worksheet #10 (UFP-QAPP Manual Section 2.5.2) Problem Definition

The problem to be addressed by the project:

Previous geophysical surveys were unsuccessful in identifying the location (x, y and z coordinates) and orientation (the line described by the series of x, y, and z coordinates) of the two 72-inch water pipelines located within the current No Dredge Zone of the Passaic River near RM 10.9 of the LPRSA. The subject field effort will employ two technologies that have not yet been used within the survey area: PES and GPR. The PES survey efforts will span the current No Dredge Zone at RM 10.9 of the LPRSA and the GPR survey will be conducted along the SE bank of the Passaic River on the premises of Riverside Park, Lyndhurst, NJ. These technologies, coupled with real time kinematic (RTK) GPS positioning technology, will enable the best possible vertical and horizontal resolution available. These results may be used to inform additional dredging of contaminated sediments from the No Dredge Zone.

The objectives of the surveys are to:

- Identify and locate the apex of each of the two 72-inch pipelines within the Passaic River at a spacing of 15 ft along the pipeline, beginning as close to the shoreline as possible, allowing for the minimum operating depth of the boat and survey gear (approximately 3 ft), and progressing to the far river bank (resulting in a target 24 transects), but at a minimum, to the river thalweg.
- Landward of the shoreline, the pipelines will be located using GPR at a transect spacing of 15 ft along the pipeline and extending approximately 75 ft (resulting in a target 5 transects), but subject to field judgments based on interferences from trees or structures. The objective of the GPR is to provide additional “validation” to the locations of the pipes in the river by “connecting” to known shoreside locations.
- Coordinates (x, y) of the apex elevation will be established to an accuracy of at least 6.0 ft per Dredging and Marine Construction Surveys established by the Federal Geographic Data Committee (FGDC, 2002). However, the equipment to be used for the work is capable of greater accuracy and the actual, estimated accuracy of the measurements will be detailed in the project report.
- Apex elevations (z) will be established to an accuracy of 1.0 ft per FGDC, 2002. However, the equipment to be used for the work is capable of greater accuracy and the actual, estimated accuracy of the measurements will be detailed in the project report.

An uncertainty evaluation will also be conducted to inform the reliability of the resulting x, y, z coordinates. This evaluation will, at a minimum, include the measurement of two, independently-established datasets (x, y, z) for at least 25% and up to 50% of the apex locations. In addition, the uncertainty evaluation will include an assessment of the calibration and verification process used during equipment set-up and quality checks repeated during survey activities. Finally, the apex coordinates (x, y, z) will be compared to pipeline construction drawings as a final check for consistency.

The remote sensing geophysical survey techniques will inform a physical probing effort to confirm, if possible, the locations of the pipelines. Tierra will develop a scope of work/QAPP for physical probing and, with USEPA approval conduct the additional work, following evaluation of the remote sensing data.

The data report will include a discussion of all field and quality control activities, the data collected, a description of all deviations from this QAPP and an explanation for each, and tables of coordinates and plots of same.

QAPP Worksheet #11 (UFP-QAPP Manual Section 2.6.1) Project Quality Objectives/Systematic Planning Process Statements

DQOs are described in Section 3 of this QAPP and listed below:

PRIMARY STUDY QUESTIONS/NEEDS

A quantitative delineation of the locations of two 72-inch pipelines crossing the Passaic River at RM 10.9 of the LPRSA. This delineation will include x, y and z coordinates of the pipelines at every 15 ft across the channel, allowing for the minimum operating depth of the boat and survey gear (approximately 3 ft), and every 15 ft on land, allowing for interferences from trees and structures.

PROGRAM GOALS

To obtain the data required by the Primary Study Need defined above.

ALTERNATIVE ACTIONS

N/A

For the planning process associated with this task the following are addressed:

WHO WILL USE THE DATA?

USEPA and its Partner Agencies, Tierra, Occidental, and the CPG.

WHAT WILL THE DATA BE USED FOR?

The data will be used by EPA, Occidental, and the CPG in support of identifying and locating two 72-inch water mains located in the No Dredge Zone at RM 10.9.

WHAT TYPE OF DATA IS NEEDED?

Elevation of the top of the water pipelines (referenced to NGVD29) and associated New Jersey State Plane coordinates (NAD83).

HOW MUCH DATA ARE NEEDED?

The goal of this survey is to determine the x, y and z coordinates of the pipelines every 15 ft along the pipelines in water depths greater than 3 ft for a total of 24 position-depth pairs per pipeline and every 15 ft along the pipeline landward of the shoreline for a total of five position-depth pairs per pipeline. The field conditions will determine exactly how much of the survey area can be safely navigated by the vessel and accessed by the GPR.

The PES survey will be conducted by running survey lines perpendicular and parallel to the expected orientation of the pipelines based on the available design drawings and any other available information. Running the lines perpendicular to the pipelines allows for optimal identification of the apex of the pipelines and minimizes the amount of possible interference caused by reverberation and reflection. Once the pipelines have been identified, several lines will be collected parallel to the pipelines' orientation with the intention of identifying other possible subsurface debris that may have been missed due to the implementation of a grid-based survey plan. The length of the perpendicular transects will, at a minimum, cover the area between the 30 ft upriver offset from the estimated location of the upriver pipeline and the 30 ft downriver offset from the estimated location of the downriver pipeline as described in CH2M Hill 2013. The lengths of the along-pipeline transects will be determined in the field based upon data collected during the perpendicular transects.

The GPR survey will be conducted in the same manner as the PES survey. Transects will be run perpendicular to the known orientation of the pipelines, recording depth and position data. In addition, the topography of the land surface along each of the transects will be surveyed to establish the distance from the land surface to the apex of the pipelines. The perpendicular transects will cover the same extent as the PES perpendicular transects.

During the survey, a real time kinematic (RTK) Global Positioning System (GPS) will record position and antenna height information at a minimum rate of 5 Hz.

The sound velocity probe will be used to measure the water column speed of sound. A minimum of one reading will be taken each day. However, based on the judgment of the Survey Field Task Lead, additional measurements may be performed to more accurately define the speed of sound profile.

A bar-check of the PES performance will be performed at least once per day.

HOW GOOD DO THE DATA NEED TO BE?

PES

The best attainable vertical accuracy of the PES is 4 cm + 0.02% of water depth and, depending on factors such as sediment type, sediment thickness and the presence of gaseous bodies, this accuracy may degrade or the signal may be absent. The amount of degradation will not be known until the survey setup and optimization and post-survey data processing have been conducted. In order to achieve this accuracy, a PES optimization test will be conducted prior to initiating the pipeline surveys.

The PES optimization test is a trial-and-error process whereby the acoustic frequency and gain levels are adjusted to obtain maximum signal penetration into the sediment. Since signal penetration is dependent upon a number of factors, including grain size, grain type, water properties, and gas in the sediment, the optimization test will be conducted throughout the area of interest.

GPR

The vertical accuracy of the GPR will depend on the quality of a Common Mid-point (CMP) survey (see below) and hence on the presence of subsurface interference anomalies like roots or anthropogenic materials, soil density, and soil type. Thus, accuracy will be specific to each site and typically of the order +/- 10% of the depth value recorded.

A CMP survey will be conducted to most accurately estimate the radar velocity within the subsurface at the site. This will then allow the most accurate conversion of two-way travel time to depth. A CMP survey is best done in an area with flat lying reflectors and relies on changing the antenna separation to increase the signal path length from the mid-point reflector. The resulting data can then be processed using a semblance analysis routine to extract average velocities to the reflectors.

RTK GPS

The horizontal and vertical accuracy of the Leica GX1230 GPS is 10mm + 1ppm (part per million) and 20mm + 1ppm, respectively, for all kinematic observations (where the ppm value is derived from the distance between the base station and the rover – the baseline). To optimize the positional accuracy, the baseline distance will be minimized to the extent practicable.

Sound Velocity

The YSI CastAway sound velocity probe has an accuracy of 0.15 m/s in the water depths in the vicinity of RM 10.9.

Motion Reference Unit

The ORE Motion Reference Unit as the following accuracy specifications:

- Dynamic accuracy: 0.25 degrees (RMS)
- Compass accuracy: 0.3 degrees
- Heave accuracy: 5 cm or 5% of scale

General

All field-collected data are subject to conditions that will degrade instrument performance. Therefore, the accuracies and performance measures cited in Sections 1 and 2 of this QAPP are for guidance only. The project-level performance/acceptance criteria cited in Section 3, Data Quality Objectives, apply to the final data product: 6 ft horizontal and 1 ft vertical, per FGDC, 2002.

WHEN WILL THE DATA BE COLLECTED?

The data are planned to be collected during Summer 2014.

QAPP Worksheet #12 (UFP-QAPP Manual Section 2.6.2) Measurement Performance Criteria Table

Matrix	N/A				
Analysis	N/A				
Concentration Level	Not available				
Sampling Procedure	**Analytical Method/SOP**	**Data Quality Indicators**	**Measurement Performance Criteria**	**QC Sample and/or Activity Used to Assess Measurement Performance**	**QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)**
Elevation/position accuracy	GPS SOP	Accuracy/Bias, Precision	10mm + 1ppm (horizontal) and 20mm + 1ppm, (vertical)	GPS QA/QC	S
Measurement of subsurface elevation	PES SOP	Accuracy/Bias, Precision	4 cm + 0.02% of water depth	PES Optimization	S
Measurement of subsurface elevation	GPR SOP	Accuracy/Bias, Precision	The accuracy will be specific to each site and typically of the order +/- 10% of the depth value recorded	Common Mid-point Analysis	S

QAPP Worksheet #13 (UFP-QAPP Manual Section 2.7) Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (Originating Organization, Report Title, and Date)	Data Generator(s) (Originating Org., Data Types, Data Generation/ Collection Dates)	How Data Will Be Used	Limitations on Data Use
Construction Drawings				
Old Pipeline Profile drawing	United Water, not cited, unknown	Unknown, vertical section, unknown	Inform survey	No limitations on intended use.
New Pipeline Profile drawing	Department of Streets and Public Improvements, Bureau of Water; not cited; April 16, 1930.	Unknown, vertical section, unknown	Inform survey	No limitations on intended use.
Geophysical Surveys of LPRSA Recently Performed by Others[1]				
Magnetometer and Sub-bottom Profiler survey	Ocean Surveys, Inc. (OSI) Marine Geophysical Surveys Submarine Utility Crossings Passaic River, 2013	Magnetometer and Sub-bottom profiler survey (Edgetech Geostar "Chirp" and Geometrics G882) performed by OSI at RM 10.9 in the LPRSA in 2013.	Identify the locations of existing utilities in the river that potentially could be affected during planned sediment removal operations in the area.	Sub-bottom data were not included in the final report because they were unable to locate the pipeline; specifics unclear.
Lower Passaic River Bathymetry Survey	AECOM, Periodic Bathymetry Survey, Fall 2011 Post Hurricane Irene Survey Report, 2013	Multibeam bathymetry survey performed by Gahagan & Bryant Associates, Inc. (GBA) on behalf of the Cooperating Parties Group (CPG) as part of the Lower Passaic River Remedial Investigation (RI) and Feasibility Study (FS).	To assist in understanding the sediment surface elevation for planning and implementing the pipeline survey.	No limitations on intended use.

QAPP Worksheet #14 (UFP-QAPP Manual Section 2.8.1) Summary of Project Tasks

Field Work:

Field work will begin with the establishment of survey control in the area of the PES and GPR surveys. RTK GPS positions, based on data from the locally-established base station, will be used in conjunction with the PES and GPR surveys to record the locations (x, y) of sub-bottom "hits" (z) of anomalies that are determined to be the two 72-inch water pipelines.

Three temporary benchmarks will be established and certified by a New Jersey licensed Professional Land Surveyor (PLS). These temporary benchmarks will be established in New Jersey State Plane Coordinate System (2900), NAD 83 and National Geodetic Vertical Datum 1929. Tying at least one of these three temporary benchmarks into an existing NJ monument will also be the job of the PLS and will be performed prior to survey efforts. Criteria for the establishment of these benchmarks will meet or exceed those for Dredging and Marine Construction Surveys established by the FGDC, 2002.

The GPS "rover" unit will be checked against a known temporary benchmark (or established survey monument) at the beginning and end of each day of field work. If the position and elevation data are outside of the established accuracy limits, a new GPS unit will be acquired and used. These quality control checks will be recorded in the field logbook.

The PES will be setup on the survey boat with the GPS antenna affixed directly above the transducer on the PES mounting pole. In addition, the Motion Reference Unit will be installed/connected to the mounting pole to compensate for boat motion during surveying. The distance from the GPS antenna point-of-measurement to the transducer point-of-measurement will be entered into the PES data logging software and recorded in the field logbook. In addition, the distance from the transducer point-of-measurement to the water surface will be measured and this information will also be entered into the PES data logging software and recorded in the field logbook. The measurement between the antenna and sonde will be resolved to the nearest 0.01 ft; the measurement from the sonde to the water surface will be resolved to the nearest 0.1 ft. If the GPS or PES components are dislodged (e.g., if bumped) or dismantled, new distances will be measured and entered into the data logging software and recorded in the field logbook; and the reason for the new readings described.

Surface water speed of sound measurements will be made using a speed-of-sound probe and this information will be entered into the PES data logging software. PES accuracy will be confirmed using standard bar-check methods.

The GPR will be setup in much the same way as the PES. The rover GPS will be affixed to the GPR, recording the distance between the measurement point of the GPS and the measurement point of the GPR in the data logging software and in the field logbook. If the spatial relationship between these two data measurement points changes, for whatever reason, the distance will be re-measured and the data re-entered into the software and the logbook, along with a reason for the new measurement.

Following setup, both surveys (PES and GPR) will be conducted in a similar manner. The survey team will proceed in an orientation perpendicular to the known orientation of the pipelines, recording x, y, z data and noting anomalies that could be the pipelines. Up to 50% of the survey lines will be repeated, to the extent practicable, in the opposite direction to confirm any "hits" noted in the initial-direction transit. Other anomalies will be investigated at the discretion of the Survey Field Task Lead.

PES surveying near the shoreline is be planned to occur in conjunction with the time of predicted high water in East Rutherford based on the National Oceanic and Atmospheric Administration's tide predictions (http://tidesandcurrents.noaa.gov/gmap3/index.shtml?type=TidePredictions&region). GPR surveying will begin as close to the shoreline as trees, foliage, and structures allow. Starting and ending points for the GPR transects will be established so as to avoid trees in the area and, in the vicinity of the shoreline, a transect will be located as close to the tree line as possible. In addition, a Total Station with equivalent accuracy to the RTK GPS will be used for the GPR work in areas where tree cover may impact satellite reception. There will be no GPR surveying on the mudflat.

Survey transects, both in-water and on land, will be spaced at (nominally) 15 ft, with the initial transects as described in the previous paragraph. The PES survey will progress at (nominal) 15 ft spacing to the far shore, but at a minimum, to at least the line of the thalweg. The GPR will progress at the (nominal) 15 ft spacing to a line at least 75 ft from the initial transect.

The lengths of the transects will, at a minimum, extend between the outside extents of the thirty (30) foot offsets established by the Jersey City Municipal Utilities Authority (JCMUA) for the CPG dredging activities (CH2M HILL, 2013).

Quality Control Tasks: QC tasks will be completed before survey operations; this includes GPS QA/QC, PES Optimization, and GPR Common Midpoint Analysis. In addition, performance of the sound velocity probe and motion reference unit will be confirmed.

Secondary Data: All relevant secondary/historical data are summarized on Worksheet #13.

Data Management Tasks: The raw PES and GPR data are stored in "real-time" in the data logging systems associated with each of the PES and GPR units. These data will be backed-up to an independent data storage device at the conclusion of each survey day (e.g., flash drive, second computer, client server, etc.). The backed-up data, if on a physical storage device, will be transported separately from the data in the data logging system. During data processing, no raw data will be deleted and interim data products will be retained.

Documentation and Records: Project-related records (e.g., field, raw data, and processed data) are summarized on Worksheet #29.

Assessment/Audit Tasks: Field audits will be scheduled in accordance with Worksheet #31.

Data Review Tasks: Field data will be reviewed as described in Worksheet #34.

Reporting Tasks: Deliverables are summarized in Worksheet #16 and include a summary report and submittal of raw and processed data files.

QAPP Worksheet #16 (UFP-QAPP Manual Section 2.8.2) Project Schedule/Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Project Status	Tierra	First month following QAPP approval	Monthly until project completion.	Progress report	20th of each month
Planning and Development of Study Objectives	Tierra	Completed	Completed	QAPP	QAPP submitted May 9, 2014. Revise as needed
Performance of GPR and PES Survey	UoI	August 2014	August 2014	Raw and processed data files	Delivered along with the processed data
Processing of Survey Data	UoI	August/September 2014	October 2014	Processed data files, and supporting data.	Approximately 60 days following completion of field survey
Quality Review and Evaluation of Collected Data	UoI	August 2014	October 2014	Included in Survey Summary Report	October 31, 2014
Preparation and Delivery of Survey Summary Report	UoI/Tierra	September 2014	October 2014	Survey Summary Report	October 31, 2014

Note: Specific date of initiation of the survey is dependent on equipment availability.

QAPP Worksheet #17 (UFP-QAPP Manual Section 3.1.1) Sampling Design and Rationale

Describe and provide a rationale for choosing the sampling approach (e.g., grid system, biased statistical approach):

Previous attempts to locate these two pipelines have failed for various, unknown reasons. The two technologies proposed have not been utilized at this site.

This survey will be conducted using a gridded survey plan. These lines will be run at 15 ft spacing perpendicular to the orientation of the pipelines. Once the pipelines have been mapped within the longitudinal and lateral extents described earlier, several survey lines will be collected parallel to the pipeline with the intention of identifying other possible subsurface anomalies that could have been missed by the limited footprint size and the depth dependent coverage of the PES. The length and exact orientation of these lines will be selected at the discretion of the surveyor based on the data collected during the perpendicular transects. Like the previous sonar surveys, all GPS data will be recorded within the PES processing computer and merged with the sonar data in real-time..

The GPR is a land based sensor that uses electromagnetic radiation pulses to detect differences in the subsurface medium. This survey will be conducted by surveying lines at a 15 ft spacing interval, beginning as close as possible to the SE river shoreline. Once the orientation of the pipeline has been confirmed, a line will be run along the apex of each pipeline in an attempt to map the apex of the pipelines in their entirety. All GPS data will be recorded within the GPR processing computer and merged with the GPR data in real-time..

The transect spacing of 15 ft is expected to provide sufficient resolution to produce a detailed map/graphic showing the location and slope of the pipelines throughout the No Dredge Zone. In the area where the pipelines have the greatest slope, a minimum, of 4 data points are expected to be collected.

Describe the sampling design and rationale in terms of what matrices will be sampled, what analytical groups will be analyzed and at what concentration levels, the sampling locations (including QC, critical, and background samples), the number of samples to be taken, and the sampling frequency (including seasonal considerations):

As no physical samples will be collected or analyzed, many of the items noted in this entry are not applicable.

The PES and GPR data will be recorded at a rate no slower than once per second and as fast as the depths will allow. This (water or land) will provide nearly continuous data coverage on anomalies noted by the two units. Transect spacing of 15 ft will provide sufficient detail to allow the elevation and alignment of the two pipelines to be definitively plotted within the area of the RM 10.9 No Dredge Zone.

QAPP Worksheet #18 (UFP-QAPP Manual Section 3.1.1) Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ Identification Number	Matrix	Depth (units)	Survey Type[1]	Concentration Level	Number of Samples[2]	Sampling SOP Reference	Rationale for Sampling Location
LPRSA RM 10.9	Elevation (ft – NGVD29)	ft	PES	N/A	Transects will be run perpendicular to the pipelines at a 15 ft interval beginning as close as possible to the SE shoreline. The selected spacing will provide approximately 4 data points where the pipeline may slope to the river (based on the JCMUA New Pipeline Profile referenced in WS #13). Where the pipeline is not sloped, 15 ft spacing will be more than sufficient to define the pipes' elevations. Transects run parallel to the pipeline will be collected at the discretion of the surveyor based on observations made during survey operations.	PES SOP	To provide quantitative data to enable defining/plotting the locations of the apex of the two 72-inch pipelines located at RM 10.9 of the LPRSA

Sampling Location/ Identification Number	Matrix	Depth (units)	Survey Type[1]	Concentration Level	Number of Samples[2]	Sampling SOP Reference	Rationale for Sampling Location
LPRSA RM 10.9	Elevation (ft – NGVD29)	ft	GPR	N/A	Transects will be run perpendicular to the pipelines at a 15 ft interval beginning as close as possible to the SE shoreline. The selected spacing will provide definition of the extended trend of the pipelines underground outside of the alignment of the river. One transect will be run along the apex of each pipeline in an attempt to map the apex of the pipelines in their entirety	GPR SOP	To provide quantitative data for the location of two 72-inch pipelines located at RM 10.9 of the LPRSA

QAPP Worksheet #21 (UFP-QAPP Manual Section 3.1.2) Project Sampling SOP References Table

The following is a list of SOPs associated with project activities including, but not limited to, field data collection, equipment testing, inspection and maintenance, supply inspection and acceptance, and data analysis.

Reference Number	Title, Revision Date and/or Number	Originating Organization	Equipment Type	Modified for Project Work? (Y/N)	Comments
N/A	Field Documentation SOP No. 1;	UoI	N/A	Yes	Appendix A
N/A	Data Management SOP No. 2;	UoI	N/A	Yes	Appendix A
N/A	PES SOP No. 3;	UoI	PES	Yes	Appendix A
N/A	GPR SOP No. 4;	UoI	GPR	Yes	Appendix A
N/A	Positioning SOP No. 5;	UoI	GPS	Yes	Appendix A

Procedural modifications to these documents may be warranted depending upon field conditions. Substantive modification will be approved in advance by the Project QA Manager and PM and communicated to the Project Coordinator and to the USEPA RPM. Deviations will be documented in the field records.

QAPP Worksheet #22 (UFP-QAPP Manual Section 3.1.2.4) Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Real Time Kinematic Global Positioning System	Verify and check all horizontal and vertical control and datum before beginning any survey	Per manufacturer's instructions	Accuracy of position	Alignment with known benchmark	Prior to survey and daily thereafter	Manufacturer's published accuracy	Resurvey for positional accuracy; replace unit if necessary.	Survey Field Task Lead or designee	GPS SOP
Parametric Echosounder	PES optimization procedures before survey operations	Per manufacturer's instructions	Selecting frequencies to maximize penetration depths	PES Optimization	Prior to survey and as needed thereafter	Manufacturer's published accuracy	Recalibrate or replace	Survey Field Task Lead or designee	PES SOP

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GPR	Perform Common MidPoint Analysis survey to determine GPR radar velocity in soils of interest	Per manufacturer's instructions	Selecting velocities to maximize penetration depths	Common Midpoint Analysis	Before survey operations and as needed thereafter	N/A	Recalibrate or replace	Survey Field Task Lead or designee	GPR SOP
Speed-of-sound from CTD	Manufacturer	Per manufacturer's instructions	Independent laboratory check of calibration	Records of calibration and checks.	Per manufacturer's instructions	Per manufacturer's instructions	Recalibrate.	Survey Field Task Lead or designee	PES SOP

QAPP Worksheet #27 (UFP-QAPP Manual Section 3.3.3) Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): N/A

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): N/A

Sample Identification Procedures: N/A

Chain-of-Custody Procedures: N/A

Chain of Custody Procedure: N/A

Transfer of Custody and Shipment: N/A

Sample Packaging and Shipping Requirements: N/A

Laboratory Custody Procedures: N/A

Final Evidence Files
All field data including raw data files and navigation files will be provided to Tierra and will be retained by Tierra along with associated field records and other related correspondence.

Final evidence files as retained by Tierra will include, but not be limited to, correspondence (paper and email), plans, contractual documents, maps and drawings, field data, calculations, assessment reports, and progress and data reports. This information will be maintained in a secure area according to the procedures outlined in the Data Management SOP.

QAPP Worksheet #29 (UFP-QAPP Manual Section 3.5.1) Project Documents and Records Table

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
N/A	Field notes, field data sheets, field logbooks	Data processing notes	Reports of field audits	Progress reports
	Field instrument calibration records	Communication records	Data evaluation reports	Final report - Prepared and submitted to clients and USEPA
	Field measurement data		QA reports to management	
	QAPP and HASP		Corrective action reports and results	
	Corrective action reports and results			
	Documentation of field modifications and non-conformances			

This section describes the project data management process for tracking the data from their generation through final use and/or storage. All project data, communications, and other information must be documented in a format useable to project personnel.

Project Document Control System

Project documents are controlled according to the Data Management SOP (Appendix A) which addresses maintaining and managing hardcopies and electronic copies of all project-related documents. Electronic copies of all information relating to this project are maintained on the project network files; access to these files is limited to authorized project personnel. All project data and information must be documented in a standard format which is usable by all project personnel.

Data Recording

Almost all of the data generated during this investigation (position, depth, RTK antenna height elevations) will be captured electronically. Any manually-recorded data will be entered by hand into bound field logbooks and later transferred to an electronic record.

Data Quality Assurance Procedures

UoI will monitor the survey progress to verify that data are collected and recorded as planned. The survey contractor must maintain a QC Plan to which they adhere and which addresses all data-generating aspects of daily operations. A policy of continuous improvement will allow all data generation processes to be reviewed and modified, as needed, to meet project objectives. Audits of field operations will ensure that data collection, documentation, and QC procedures are being followed.

Laboratory Data Transmittal

N/A

Data Storage and Retrieval

Completed forms, logbooks, photographs, data packages, and electronic files will be transmitted to the UoI Project Document Control Manager at the completion of the survey. Raw data and electronic files of all field data and QC analyses must be maintained by the survey contractor in accordance with the terms of their contract with Tierra. Project closeout will be conducted in accordance with contractual obligations. As required by the UAO (USEPA 2012)for the LPRSA, all data and other project records will be made available to USEPA. Records will be retained in accordance with the UAO requirements.

The data transfer to USEPA will include the raw data files, processed data files, and supporting data files (line, position).

QAPP Worksheet #31 (UFP-QAPP Manual Section 4.1.1) Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Actions	Person(s) Responsible for Monitoring Effectiveness of Corrective Actions
Technical Oversight of Field Activities	Once during the first day of field operations; follow-up audits as necessary	Internal	Tierra	Tierra Field Oversight or designee	Data Management Task Manager/ Tierra Project Coordinator	Data Management Task Manager/ Field Oversight	Tierra PM

QAPP Worksheet #32 (UFP-QAPP Manual Section 4.1.2) Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field System Audit	Written audit report	Tierra PM, UoI Survey Manager	Verbal summary of major findings within 24 hours; written report within 3 weeks.	Memo	Tierra PM, UoI Survey Manager	Three weeks

Non-Conformance/QC Reporting

A non-conformance is defined as an identified or suspected deficiency in, or deviation from, procedures described in an approved document (e.g., improper surveying techniques, improper equipment setup or calibration, errors in calculations or errors in computer algorithms); an item where the quality of the end product itself or subsequent activities conducted using the document or item would be affected by the deficiency; or an activity that is not conducted in accordance with established plans or procedures. Any project staff member that discovers or suspects a non-conformance is responsible for initiating a non-conformance report to the Project QA Manager. The Project QA Manager will evaluate each non-conformance report and provide a response describing the actions to be taken and assigning responsibility for the corrective action. The appropriate Task Manager will verify that the nonconforming item or procedure is not used until the corrective action has been performed and found to produce acceptable results. If the non-conformance involves instrumentation or equipment, the device must be tagged to indicate it is defective and not to be used.

All non-conformance reports will be maintained in the project file.

Assessment

Assessment activities will measure the effectiveness of the project implementation and associated QA/QC activities. Audits are used as a means of monitoring the performance of field and data processing activities and are conducted by the Project QA Manager or another member of the QA staff. Audits will include systems audits which are more qualitative in nature and will be made at appropriate intervals to ensure

that all aspects of the QA program are operative. Performance audits are quantitative audits which are conducted to assess the accuracy of measurement systems.

Systems audits will be conducted for field and processing operations to assess implementation of QA/QC requirements and determine if the systems under review are capable of meeting project DQOs. Any minor deficiencies noted during an audit will be corrected as soon as possible according to an agreed-upon schedule. If a major deficiency is noted during an audit, a stop work order will be issued until the deficiency can be corrected and the effectiveness of the corrective action measured and documented. A stop work order may be issued by Project QA Manager who will notify the PM. The conditions which lead to a stop work order must be documented in sufficient detail to clearly define the problem and identify possible corrective measures. All communications among project staff which address evaluation of the problem and appropriate solutions must be attached to the stop work order. The Project QA Manager and the PM must agree in writing to resume work after review of the data supporting correction of the deficiency. The Project QA Manager will maintain a corrective action log which lists deficiencies that were noted, the individual(s) responsible for follow-up, documentation of the effectiveness of the corrective actions taken, and implementation of procedures to prevent recurrence of the problem.

A written report will be prepared for all audits regardless of the outcome and submitted to Tierra. Any modifications to the existing program, corrective actions required, or the need for additional audits will be documented.

Type of Report	Frequency (e.g., daily, weekly, monthly, quarterly, annually)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Progress Reports	Monthly	Due the 20th of each	Project Coordinator	USEPA RPM
Audit Report	Once	Within first 3 days of field operations	Project QA Manager or designee	USEPA RPM; Tierra Project Coordinator
Internal Field Audit Report	1 per audit conducted	Within 30 days of audit completion	Project QA Manager or designee	USEPA RPM; Tierra Project Coordinator
Nonconformance Report	As needed	When nonconformance identified	Project QA Manager or designee	USEPA RPM; Tierra Project Coordinator
Corrective Action Reports	When corrective action is required	When corrective action is implemented	Project QA Manager or designee	USEPA RPM; Tierra Project Coordinator

QAPP Worksheet #34 (UFP-QAPP Manual Section 5.2.1) Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification
Field data	Field data will be reviewed for completeness to ensure that data for positioning and depths were collected at the desired frequency and locations/transects.	Internal	UoI Survey Manager or designee
Processed data	Processed data will be reviewed prior to release to ensure completeness of reported results.	Internal	UoI Survey Manager or designee
Assessment actions and reports	QA/QC process will be reviewed for agreement with QAPP to ensure that all necessary audits and assessments have been performed.	Internal	Tierra Project Coordinator

QAPP Worksheet #35 (UFP-QAPP Manual Section 5.2.2) Validation (Steps IIa and IIb) Process Table

Step IIa/IIb	Validation Input	Description	Responsible for Validation
IIa	GPR, PES, GPS SOP's	Verify conformance to approved procedures and verify that deviations from procedures or criteria were documented	UoI Survey Manager or designee on the project team
IIa	Field records, database output	Verify that transcription of field data from field forms to electronic files (if applicable) and processing of data was accurate and complete	UoI Survey Manager or designee on the project team
IIa	Field records, audit reports, deliverables	Verify conformance to contractual specifications	Tierra Project Coordinator or designee on the project team
IIa/b	Field observations, field records	Verify conformance to procedures and criteria specified in QAPP and assess impact of deviations	Tierra Project Coordinator or designee on the project team
IIb	Field records, processed data	Review data and processing procedures to ensure conformance with the project quality requirements. This will include review of positioning controls, survey quality controls (bar check), data files, and speed-of-sound corrections	UoI Survey Manager
IIb	Assessments, audit reports	Verify that data evaluations and technical audits were performed per the QAPP	Tierra Project Coordinator

QAPP Worksheet #37 (UFP-QAPP Manual Section 5.2.3) Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:
UoI will review the data collected for interference, consistency and continuity after survey operations are complete. Survey goals along with QA/QC quantification will be addressed and annotated accordingly. Problems experienced during data collection and processing will be addressed along with potential remedial solutions.

Describe the evaluative procedures used to assess overall measurement error associated with the project:
Each data source will be evaluated for resultant error after all field activities have been considered (e.g., manufacturers' cited accuracies for each piece of equipment are "idealized"). Actual uncertainties of each system component will be assessed in relation to associated components (e.g., PLS and GPS) and the expected overall measurement error will be documented.

Identify the personnel responsible for performing the usability assessment:
The usability assessment will be performed by the UoI Project QA Manager.

Describe the documentation that will be generated during usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:
The documentation generated during the usability assessment will be developed by UoI and will include a memorandum that describes the information that was reviewed and the results of this review; it will also include a recommendation on overall data usability and limitations on specific data points.

Section 3.
Data Quality Objectives

3. Data Quality Objectives

DQO Step	**DQO 1: Develop a subsurface dataset using PES and GPR survey technologies to identify the apex locations of two 72-inch pipelines as they cross from the SE bank of the Passaic River to the river thalweg in the vicinity of RM 10.9.** **Description**
STEP 1 **State the problem**	Two 72-inch water-pipelines lay within a current No Dredge Zone in the vicinity of RM 10.9. The pipeline locations need to be identified to within 1.0 ft of their true elevation to meet project dredging specifications (consistent with FGDC, 2002). Currently, no position or depth information exists on these pipelines that meet the dredge planning specifications.
STEP 2 **Identify the goals of the study**	**Primary Study Questions/Needs** • In support of ongoing sediment removal action efforts within the Passaic River, a geophysical survey has been requested to identify and locate two 72-inch pipelines within the No Dredge Zone in the vicinity of RM 10.9 within the LPRSA. • The primary goal of the survey efforts is to locate the pipelines and determine their respective depth below the sediment surface. **Program Goals** • To provide x, y and z coordinate positions of the apex of the pipeline at a linear separation along the pipelines of 15 ft. **Alternative Actions** • N/A
STEP 3 **Identify the information inputs**	**New Data Needed** • PES and GPR data throughout the accessible areas of the proposed survey site at RM 10.9 of the LPRSA. **Existing Field Data to Be Compared with Data Collected during This Investigation** ▪ None

DQO Step	**DQO 1: Develop a subsurface dataset using PES and GPR survey technologies to identify the apex locations of two 72-inch pipelines as they cross from the SE bank of the Passaic River to the river thalweg in the vicinity of RM 10.9.** **Description**
STEP 4 **Define the boundaries of the study**	**Geographic Area** The survey area is located in and along the SE bank of the Passaic River at RM 10.9 of the LPRSA. It covers approximately 40,000 square feet. **Time Frame** The survey is planned for Spring/early Summer 2014.
STEP 5 **Develop the analytical approach**	The purpose of this survey will be to provide x, y and z positional data for two 72-inch diameter water pipelines that are located within the current No Dredge Zone in the vicinity of RM 10.9.
STEP 6 **Specify performance or acceptance criteria**	For the intended data use – to inform dredging in the vicinity of the two 72-inch pipelines – the minimum accuracy requirements in FGDC, 2002 for Dredging and Marine Construction Surveys – New Construction Plans will be used: 6 ft horizontal and 1 ft vertical.
STEP 7 **Develop the detailed plan for obtaining data**	Details of the plan are presented in the QAPP worksheets and supporting Appendices.

4. References

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Tierra. 2005. Newark Bay Study Area Remedial Investigation Work Plan: Sediment Sampling and Source Identification Program, Newark Bay, New Jersey, Phase I. Revision 1. Volumes 1-3. September.

USACE. 2006. Geomorphological/Geophysical Characterization of the Nature and Dynamics of Sedimentation and Sediment Transport in Newark Bay focusing on the Effects related to Continued and Future Federal Navigation Channel Deepening and Maintenance. Contract #: W912DS-06-D-0001.

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USEPA. 2005. U.S. Department of Defense, and U.S. Department of Energy. Intergovernmental Data Quality Task Force. Uniform Federal Policy for Quality Assurance Project Plans. Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. USEPA 505-B-04-900A. Final Version 1. March.

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APPENDIX A
SOPs

Standard Operating Procedure
No. 1

Field Documentation

May 2014

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities associated with the Quality Assurance Project Plan (QAPP) for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar (Tierra Solutions, Inc. 2014). Appropriate documentation of field activities provides an accurate and comprehensive record of the work performed, sufficient for a technical peer to reconstruct the day's activities and determine that necessary requirements were met, without relying on the collector's memory.

This SOP may change depending upon field conditions or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Project Coordinator and the U.S. Environmental Protection Agency Remedial Project Manager. The ultimate procedure employed will be documented in the Final Work Plan prior to the start of work.

Other SOPs will be utilized in conjunction with this procedure:

- SOP No. 2 – Data Management
- SOP No. 3 – Parametric Echosounder (PES) Surveying
- SOP No. 4 – Ground Penetrating Radar (GPR) Surveying
- SOP No. 5 – Positioning

2. Procedures

In all instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2.1 General Procedures

Pertinent field information will be recorded in a logbook and/or appropriate forms (as included herein or additional forms developed by the project team) in black, ballpoint pen. If weather conditions do not allow for a ballpoint pen to be used, a thin-tipped Sharpie®, or equivalent, may be used. Alternatively, electronic methods of recording field information may be utilized. All content and guidance for the logbook/form documentation can apply, as appropriate, to electronic logs at the discresion of the field staff. If field records are being kept electronically, an appropriate backup procedure will be implemented. At a minimum, the procedure will include saving data to a removable storage device (i.e., flash drive, external hard drive, etc.) at the end of each day. The backup device(s) will be stored in a location separate from the laptop or primary recording device.

A key that describes each entry will be provided for the forms. Logbook entries will be factual and observational (i.e., no speculation or opinion), and will not contain any personal information or non-project-related entries. Separate and dedicated logbooks will be kept for different operations running concurrently; individual tasks making up each operation will be maintained in the same logbook, if possible. The cover and binding of each logbook will be labeled to identify the operation and dates included within the logbook; each page in the logbook will be consecutively numbered.

A page header will appear on the first page of each day's notes in the logbook, and activities for each day will be recorded on a new page. The page header will include:

- name of author and other personnel on site (and affiliated organization if applicable)
- date
- time of arrival
- current weather and tidal conditions, and weather forecast for the day

An abbreviated header, limited to the date, will appear at the top of each additional page for the active date. The Daily Activity Log (see attachment), to be completed each day, will require similar header information.

Field activities and other events pertinent to the field activities will be documented in chronological order at the time of occurrence, to the extent possible. Any entries recorded significantly after the fact will be dated as such. Times will be recorded using 24-hour notation for each entry. At a minimum, documentation in a logbook will include the following:

- names of visitor(s) to the work location being documented in the logbook, including time of arrival and departure, the visitor's affiliation, and reason for visit
- summary of project-related communications, including names of people involved and time
- time daily work commences and ceases
- start and stop times of new tasks
- start and stop times of breaks
- safety or other monitoring data, including units with each measurement
- deviations from scope of work
- progress updates
- problems/delays encountered
- unusual events
- signature or initials of author on every page

A single line will be drawn through incorrect entries and the corrected entry written next to the original strikeout. Strikeouts are to be initialed and dated by the originator.

If there are additional lines on the page at the end of the day's activities, a line will be drawn through the empty space, initialed, and dated, leaving no room for additional entries.

The logbook will cross-reference information documented in the field forms.

Photographs will be identified in the logbook by a unique numbering system. If photographs are collected by a digital camera, the file number as well as the photograph number will accompany the description of the photograph in the logbook, if practicable. At a minimum, the time the photograph was taken, the general location, a brief description, and the photographer's name will be recorded. Additional information may include: Differential Global Positioning System coordinates, direction the photographer was facing, and/or weather conditions. If necessary, an object will be included to indicate the scale of the object in the photograph.

Any electronic files used for recording the field observations will have a file saved each day (not including the backup file procedure) with an identifier that includes the date and a description of the file contents. For example: "YYYYMMDD_FieldNotes". The file will be saved in Portable Document Format for the official project file.

2.2 Additional Requirements for Field Activities

This section presents specific documentation requirements for activities to be performed. It is meant to provide guidance to project staff responsible for field documentation during these activities, and is not intended to be a comprehensive list of activities performed. These documentation procedures are meant to supplement, not replace, the required documentation presented in Section 2.1.

As noted in Section 2.1, a Daily Activity Log was developed to ensure proper documentation of field information is obtained in a consistent manner. Once completed, this log provides a summary of daily vessel logistics during survey activities, including personnel present, equipment used, and weather conditions. This log is provided as an Attachment to this SOP.

2.2.1 PES and GPR Surveys

Information regarding the PES and GPR survey activities will be recorded in the Daily Activity Log. If any procedural modifications must be implemented, the proposed change must be communicated through the project team (see QAPP for communication pathways) for USEPA approval. No procedural modifications will take place before the methods are approved. A memorandum will be developed to document the approved modifications.

2.2.2 Equipment Calibration and Maintenance

Equipment calibration will be recorded in the equipment calibration logbook. Instrument information, including the instrument manufacturer, model number, and serial number, will be recorded. Instrument calibration will be performed in accordance with manufacturer's specifications, and at the frequency specified by the manufacturer's specifications. Values measured during calibration will be recorded in the equipment calibration logbook. In addition, maintenance, problems, and repairs to the equipment will be recorded in the equipment calibration logbook.

2.3 Distribution and Maintenance of Field Documentation

Logbooks and field forms will be filed according to the QAPP and SOP No. 2 – Data Management.

Logbooks that are taken off site from the field offices will be photocopied and filed at the end of each day to mitigate against the loss of historical entries should the logbook be lost in the field.

Field data forms will be filed once they have been completed and distributed (if necessary), or at the end of each field day.

Electronically recorded field information will be backed-up or e-mailed to an offsite location at the end of each day for official project filing and backup.

Distribution of daily forms will be performed according to the needs of the project team and at the direction of the Project Coordinator or designee.

3. Quality Assurance

The personnel that are recording the field notes are to have reviewed the QAPP and supporting documentation and are to be familiar with the goals and procedures for task completion.

Entries in the field forms will be double-checked by the field crew to verify the information is correct. Completed field forms will be reviewed periodically by the Project Coordinator and/or Project Quality Assurance Manager or their designee(s) to verify that the requirements are being met.

4. Reference

Tierra Solutions, Inc. 2014. Quality Assurance Project Plan for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar. Revision 1. May.

DAILY ACTIVITY LOG
Parametric Echosounder and Ground Penetrating Radar
(Sheet 1 of 2)

Date of Field Work[1]: _____

Person Responsible for Log[2]: _____

Vessel Name/Owner of Vessel Performing Work[3] (if applicable): _____
List personnel on board vessel or in field team, affiliation, and role (if more room is needed, continue in the field logbook):

_____

_____

_____

_____

_____

_____

Time of Daily Health and Safety Tailgate Meeting and Form Completion[4]: _____

Weather Conditions and Forecast[5]: _____

Time of High Tide/Low Tide[6]:_____

EQUIPMENT SUMMARY[7]:

Equipment Name	Serial Number or Unique Identifier	Daily Calibrations/Performed By	Other Calibrations
Innomar Narrow-Beam PES (SES-2000)			
Leica GPS (GPS1200+)			
ORE Motion Reference Unit			
Pacific Crest Positioning Data Link (PDL)			
pulseEKKO Pro GPR			
YSI CastAway-CTD			

Time of Departure from Marina at Beginning of Day or time of arrival onsite: _____

Time of Return to Marina at End of Day or time survey-day concludes:_____

** If more room is needed, record information in field logbook and provide a copy of any notes in field logbook with this form**

DAILY ACTIVITY LOG KEY
Parametric Echosounder and Ground Penetrating Radar
(Sheet 2 of 2)

Description of Items:

(1) Date of activity (e.g., 12/1/2012).

(2) Name of person entering information into this form.

(3) Name of vessel performing activity.

(4) Enter time (24-hour format) that Health and Safety Tailgate Meeting was held in the morning. Tailgate form from the Health and Safety Plan should be filled out and archived with this Daily Activity Log each day.

(5) Weather forecast checked via marine radio, Newark Liberty International Airport, etc.

(6) Time of High and Low Tide for the day checked via the National Oceanic and Atmospheric Administration's website.

(7) Calibration details/schedules provided in the QAPP.

(8) Time of departure from the marina or arrival at site at the beginning of the day (24-hour format).

(9) Time of return to the marina at the end of the day or conclusion of field activities (24-hour format).

(10) Name of person entering information into this form.

Standard Operating Procedure
No. 2

Data Management

May 2014

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities associated with the Quality Assurance Project Plan (QAPP) for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar (Tierra Solutions, Inc. 2014). This SOP describes the procedures necessary to manage the survey data.

Substantive modification to this SOP will be approved in advance by the Project Coordinator and the U.S. Environmental Protection Agency (USEPA) Remedial Project Manager. The ultimate procedure employed will be documented in the Final Work Plan prior to the start of work.

Other SOPs will be utilized in conjunction with this procedure:

- SOP No. 1 – Field Documentation
- SOP No. 3 – Parametric Echsounder (PES) Surveying
- SOP No. 4 – Ground Penetrating Radar (GPR) Surveying
- SOP No. 5 – Positioning

2. Procedures

In all instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2.1 Data Handling and Management

The following sections trace the paths of data from generation to final use and storage, as well as the associated quality checks for error detection that are performed to promote data integrity. Note that no samples will be collected as part of this survey; all data will be recorded electronically and field notations/observations will be associated with quality control and safety procedures.

2.1.1 Data Recording

2.1.1.1 Field

Data and information collected in the field through visual observation or measurement may be recorded using electronic methods such as a Personal Digital Assistant,

laptop, or equivalent, or associated logbooks and forms, and will be recorded in accordance with requirements as described in SOP No. 1 – Field Documentation.

2.1.1.2 Field Data Checking

Completeness will be determined by verifying that there are no missing data or information. The field crew will verify that the data and information that are collected electronically are being recorded accurately during collection and then perform a review of the data and information at the end of each day. Accuracy will be based upon review of the recorded information and upon resolving any questions that arise during this review.

Note that if there are any deviations from the QAPP guidelines, these must be immediately communicated with the project team, including the Task Manager and the Project Quality Assurance Manager. In addition, the deviations, reasons for the deviations, and corrections/final decisions from the project team will be noted in the field logs.

All completed activity logs and Health and Safety Tailgate forms will be completed in accordance with the site-specific Health and Safety Plan and will be kept by the field representative in a binder until the fieldwork is completed. The completed binder will be handled in accordance with hard copy management, described in Section 2.2.1.

2.2 Data Tracking and Control

The following sections discuss the procedures for data tracking, storage, archiving, retrieval, and security for both hard copy and electronic data and information.

2.2.1 Data Storage, Archiving, and Retrieval

2.2.1.1 Hard-Copy Files

Hard copies of project documentation and data will be placed in the project file, parts of which will exist in several locations, including:

- University of Illinois Urbana - Champaign
- Tierra, East Brunswick, New Jersey.

Such files will be maintained in secure locations within each facility. Hard copies of project documentation and data will be provided to USEPA upon request.

Duplicate copies of pertinent field-related correspondence/documentation will be maintained at the field office during field operations. Once such field operations have been completed, this documentation will be transferred to the project file.

At such time that it is deemed appropriate to archive the project file, either in parts or in its entirety, files will be placed into boxes and shipped off site to a secure document storage facility. The assigned barcode identifier for each box being archived will be logged into a tracking spreadsheet along with a brief description of the contents of the box. Archived boxes will be retrieved from the document storage facility if/when necessary using the logged barcode identifier.

2.2.1.2 Electronic Files

Electronic data and information will be maintained and managed by the entities listed above using password-protected computers and on secure network drives with access limited to project personnel. Files will generally consist of the same components as the hard-copy files. Reports and field data will be in Portable Document Format (or equivalent).

2.2.2 Data Security

Hard-copy information/data will be stored in secure areas within the two project file locations. Electronic data and information will be maintained and managed using password-protected computers and on secure network drives with access limited to project personnel.

3. Quality Assurance

Appropriate quality assurance/quality control procedures will be followed during data management in accordance with the QAPP (Tierra 2012), SOP No. 1 – Field Documentation, and this SOP.

4. Documentation

Field documentation will be maintained in accordance with the QAPP (Tierra 2014), SOP No. 1 – Field Documentation, and this SOP.

5. Reference

Tierra. 2014. Quality Assurance Project Plan for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar. Revision 1. May.

Standard Operating Procedure No. 3

Parametric Echosounder Surveying

June 2014

Revision 1

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities associated with the Quality Assurance Project Plan (QAPP) for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar (Tierra Solutions, Inc. 2014). This SOP provides descriptions of equipment, field procedures, and documentation necessary to conduct the survey using parametric echosounding (PES) equipment. The objectives and locations of the survey are discussed in the QAPP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Project Coordinator and U.S. Environmental Protection Agency Remedial Project Manager. The ultimate procedure employed will be documented in the project Report.

Other SOPs will be utilized in conjunction with this procedure:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Data Management
- SOP No. 5 – Positioning

2. Procedures

In all instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2.1 Equipment List

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment and other applicable safety equipment
- survey vessel adequate for conditions in the survey area
- real time kinematic Global Positioning System (RTK GPS) including a base station and a rover receiver and external antenna
- manual(s) for RTK GPS

- calibration plate for bar check
- navigation, plotting, and computer equipment
- logbook and location map
- Parametric Echosounder equipment
- Manual(s) for PES equipment

2.2 Procedure

The PES will be setup and calibrated/tested in conformance with manufacturer's instruction manual(s), including ancillary equipment manufactured by the same, or other manufacturers, such as heave compensator, RTK GPS, and conductivity-temperature-depth (CTD) probe.

PES data will be collected across estimated alignment of the pipelines plus the 30 ft offsets on either side. Transect (lateral) survey lines will be positioned to ensure full coverage of the area. Longitudinal survey lines will be performed for quality check purposes and to look for anomalies in the survey area.

Water levels will be obtained from the RTK GPS.

Measurements near-shore will be collected during high-water periods. High-water periods will be classified as the period ranging from approximately 2 hours prior to the predicted high tide until approximately 2 hours after the predicted high tide, subject to the boat captain's assessment of boat and equipment safety. Measurements in the deeper area of the No Dredge Zone may be performed at any time. The tide level will be recorded as described in Section 4 (below) during the time period the measurements are made.

A RTK GPS base station will be established over a shore-based point referenced to survey control established by a New Jersey-licensed Professional Land Surveyor (PLS) prior to survey operations. RTK GPS corrections transmitted from the base station will allow for the collection of real-time, precision echosounding and water-level data at the survey vessel. The satisfactory operation and horizontal/vertical accuracy of the vessel-mounted RTK GPS, will be verified at another USACE monument or PLS-established temporary benchmark by recording the observed horizontal and vertical (x, y, z) data and comparing these data to the known position for that point.

Calibration checks of the PES will occur a minimum of twice each day – once before work commences and once after completing the day's activities.

Each survey line recording will be labeled with the survey line number, direction of travel, date, time, and the name of the operator.

Elevation data (z) are reported relative to the National Geodetic Vertical Datum of 1929. Position data (x, y) will be referenced to New Jersey State Plane Coordinates (NAD83)

2.3 PES Survey – General Specifications

The following are general specifications for the PES survey:

1. Survey Vessel – Adequate for conditions in the Passaic River and capable of supporting the PES positioning and sampling equipment.

2. Vessel Positioning – Horizontal positioning system capable of at least +/-1 foot accuracy and 0.5 ft vertical accuracy.

3. Vessel Navigation – Navigation system made up of computer-based software providing: display of vessel position relative to intended survey lines (with right/left helmsman indicator), navigation channel limits, aids to navigation, shoreline, and other features.

4. Soundings – The parametric Echosounder should, at a minimum, have the following performance capabilities: dual beam (100kHz and 10 kHz), heave compensation, target resolution of 5 cm and accuracy of 0.2 m + 0.02% of water depth and 0.4 m + 0.02% of water depth. Data will be logged continuously along each survey line. The PES will be calibrated for water mass sound speed using a YSI CTD.

Horizontal and vertical control for the project will be established from published monuments located along the banks of the Passaic River.

Vertical control information will be shown on drawings and charts produced.

Despite virtually worldwide, 24-hour coverage, technical difficulties with GPS satellites sometimes occurs. In the event of system-wide or other long-term problems with GPS (e.g., satellite failures), survey vessel positioning will be achieved using land-based methods. If a land-based method is selected, an SOP will be developed for its use.

2.4 Data Timing

The PES data collection and GPS timing stream will be synchronized as the GPS stream is read directly into the PES data stream during data collection. The boat speed will be kept to a minimum SOG (speed over ground) to ensure continuous bottom coverage. GPS data will be recorded at a rate of 1Hz but the PES data will be recorded at a higher rate (depending on the parameters selected). There are two possible sources of latency: (1) the time difference between the signal reflecting off of the target and being received/stamped by the system and (2) the time difference in data logging between the PES and GPS systems. The former is immeasurable due to the shallow water depth and relatively shallow depth of the target within the sediment versus speed-of-sound of the PES. Regarding the latter, there is no latency since the PES data and GPS data are tagged simultaneously, and the GPS signal is read directly into the PES processor.

2.5 Decontamination

Survey and sounding equipment that has been immersed in Passaic River waters will be cleaned/decontaminated in accordance with manufacturer requirements.

3. Quality Assurance

The PES and RTK GPS equipment will be operated and maintained in accordance with the manufacturers' operating manuals. Field instruments will be used by experienced operators familiar with field procedures and manufacturers' instructions.

The vessel-mounted RTK GPS system performance will be verified daily prior to, and after, survey activities using a temporary survey point. Vessel position during the survey will be checked using computer software (such as Hypack®). Procedures for field documentation and data management are presented in SOP 1 – Field Documentation and SOP No. 2 – Data Management.

4. Documentation

The documentation requirements for the field personnel will include recording observations made during surveying that could affect the quality of the data. Complete field documentation procedures are presented in SOP No. 1 – Field Documentation.

In addition, the following information will be recorded in a digital or hardcopy logbook (at a minimum):

- survey line number

- direction of travel
- date
- time (Coordinated Universal Time [UTC])
- time of high tide (UTC)
- equipment (i.e., brand, model, and serial number)
- equipment calibration (bar check results)
- unusual conditions
- brief description of the area around the survey line location and the weather conditions at the time of profiling
- description of transect beginning and end points

5. References

Tierra Solutions, Inc. 2014. Quality Assurance Project Plan for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar. Revision 1. May.

Standard Operating Procedure No. 4

Ground Penetrating Radar Surveying

May 2014

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for documentation of field activities associated with the Quality Assurance Project Plan (QAPP) for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar (Tierra Solutions, Inc. 2014). This SOP provides descriptions of equipment, field procedures, and documentation necessary to conduct the survey using ground penetrating radar (GPR) equipment. The objectives and locations of the survey are discussed in the QAPP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Project Coordinator and U.S. Environmental Protection Agency Remedial Project Manager. The ultimate procedure employed will be documented in the project Report.

Other SOPs will be utilized in conjunction with this procedure:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Data Management
- SOP No. 5 – Positioning

2. Procedures

In all instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2.1 Equipment List

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment and other applicable safety equipment
- real time kinematic Global Positioning System (RTK GPS) including a base station and a rover receiver and external antenna
- manual(s) for RTK GPS
- plotting and computer equipment

- logbook and location map
- GPR equipment
- Manual(s) for GPR equipment

2.2 Procedure

The GPR will be setup and calibrated/tested in conformance with manufacturer's instruction manual(s), including ancillary equipment manufactured by the same, or other manufacturers, such RTK GPS.

GPR data will be collected across the area described by the estimated locations of the pipelines plus the 30 ft offsets on either side. Transect (lateral) survey lines will be positioned to ensure full coverage of the area.

A RTK GPS base station will be established over a shore-based point referenced to survey control established by a New Jersey-licensed Professional Land Surveyor (PLS) prior to survey operations. RTK GPS corrections transmitted from the base station will allow for the collection of real-time, precision GPR and ground elevation data at the SmartCart. The satisfactory operation and horizontal/vertical accuracy of the SmartCart-mounted RTK GPS, will be verified at another USACE monument or PLS-established temporary benchmark by recording the observed horizontal and vertical (x, y, z) data and comparing these data to the known position for that point.

Calibration checks of the GPR will occur a minimum of twice each day – once before work commences and once after completing the day's activities.

Each survey line recording will be labeled with the survey line number, direction of travel, date, time, and the name of the operator.

Elevation data (z) will be reported relative to the National Geodetic Vertical Datum of 1929. Position data (x, y) will be referenced to New Jersey State Plane Coordinates (NAD83)

2.3 GPR Survey – General Specifications

The following are general specifications for the GPR survey:

1. SmartCart – For surveying large, flat, and open areas, the SmartCart configuration is preferred. Alternative configuration(s) may be substituted based on field reconnaissance or other information. Such decisions will be documented and

provided to the Project Coordinator and the USEPA Remedial Project Manager for approval.

2. Positioning – Horizontal positioning system capable of at least +/-1 foot accuracy and 0.5 ft vertical accuracy.

3. Navigation – Navigation of the SmartCart will be accomplished both visually and by computer. To support visual-referenced navigation, stakes will be driven at the beginning and end of each transect; the stakes will be surveyed to project-established accuracy; and the SmartCart will be rolled from one stake to the other while recording x, y and reflection data. At the same time, the RTK GPS-based system will be used to independently "steer" the SmartCart along the transect.

4. Soundings – The GPR should, at a minimum, have the following performance capabilities: 250MHz antennae, likely penetration in wet soil 2-3 m, resolution of 10 cm and accuracy typically +/- 10% of depth value recorded. Data will be logged continuously along each survey line.

Horizontal and vertical control for the project will be established from published monuments located along the banks of the Passaic River.

Despite virtually worldwide, 24-hour coverage, technical difficulties with GPS satellites sometimes occurs. In the event of system-wide or other long-term problems with GPS (e.g., satellite failures), survey vessel positioning will be achieved using land-based methods. If a land-based method is selected, an SOP will be developed for its use.

2.4 Decontamination

Since none of the GPR equipment will be used in the Passaic River, nor will it come into contact with Passaic River sediments, there is no decontamination required for this work.

3. Quality Assurance

The GPR and RTK GPS equipment will be operated and maintained in accordance with the manufacturers' operating manuals. Field instruments will be used by experienced operators familiar with field procedures and manufacturers' instructions.

The RTK GPS system performance will be verified daily prior to, and after, survey activities using a temporary survey point. The SmartCart position during the survey will be checked using computer software. Procedures for field documentation and data management are presented in SOP 1 – Field Documentation and SOP No. 2 – Data Management.

4. Documentation

The documentation requirements for the field personnel will include recording observations made during surveying that could affect the quality of the data. Complete field documentation procedures are presented in SOP No. 1 – Field Documentation.

In addition, the following information will be recorded in a digital or hardcopy logbook (at a minimum):

- survey line number
- direction of travel
- date
- time (Coordinated Universal Time [UTC])
- time of high tide (UTC)
- equipment (i.e., brand, model, and serial number)
- equipment calibration (bar check results)
- unusual conditions
- brief description of the area around the survey line location and the weather conditions at the time of profiling
- description of transect beginning and end points

5. References

Tierra Solutions, Inc. 2014. Quality Assurance Project Plan for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar. Revision 1. May.

Standard Operating Procedure
No. 5

Positioning

May 2014

Revision 0

1. Purpose and Scope

The purpose of this document is to define the standard operating procedure (SOP) for continuous positioning of survey equipment and/or vessels associated with the Quality Assurance Project Plan (QAPP) for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar (Tierra Solutions, Inc. 2014). Positioning will be conducted to locate equipment and/or vessel(s) with sufficient accuracy and precision to meet project objectives during surveying activities. This SOP provides descriptions of equipment, field procedures, and documentation necessary to conduct the survey using parametric echosounding (PES) equipment. The objectives and locations of the survey are discussed in the QAPP.

This SOP may change depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP shall be approved in advance by the Project Coordinator and U.S. Environmental Protection Agency Remedial Project Manager. The ultimate procedure employed will be documented in the project Report.

Other SOPs will be utilized in conjunction with this procedure:

- SOP No. 1 – Field Documentation
- SOP No. 2 – Data Management
- SOP No. 3 – Parametric Echosounder Surveying
- SOP No. 4 – Ground Penetrating Radar Surveying

2. Procedures

In all instances where this SOP will be utilized, a hard copy or electronic version will be available at the point of use.

2.1 Equipment List

The following equipment list contains materials which may be needed in carrying out the procedures contained in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- personal protective equipment and other applicable safety equipment
- survey vessel or cart adequate to support the survey equipment
- real time kinematic Global Positioning System (RTK GPS) including a base station

and a rover receiver and external antenna

- manual(s) for RTK GPS
- navigation, plotting, and computer equipment
- logbook and location map

2.2 Procedure

While this SOP provides general guidance and procedural steps, personnel performing positioning activities also should follow the appropriate sections of equipment user's manuals and have the manuals available for reference at all times.

Establish the DGPS base station over a known and accurate survey monument or a temporary benchmark established by a Professional Land Surveyor (PLS) licensed in the State of New Jersey. The operation and horizontal/vertical accuracy of the rover DGPS antennae will be verified at different monument or temporary benchmark. The x, y, z reading will be compared to the known, certified (by the licensed PLS) coordinates and recorded in the field log.

Affix the receiving antennae above the survey sensors to be used.

Ensure that coordinates are being properly recorded and logged into the respective data logging systems.

Elevation data (z) will be reported relative to the National Geodetic Vertical Datum of 1929. Position data (x, y) will be referenced to New Jersey State Plane Coordinates (NAD83)

2.4 Decontamination

Survey and sounding equipment that has been immersed in Passaic River waters will be cleaned/decontaminated in accordance with manufacturer requirements.

3. Quality Assurance

The RTK GPS system performance will be verified daily prior to, and after, survey activities using a temporary survey point.

4. Documentation

Complete field documentation procedures are presented in SOP No. 1 – Field Documentation. The following activities should be documented in the field logbook or forms, including the associated date and time:

- set-up and dismantling of base station;
- confirmation of the performance of all RTK GPS antennae, including quantitative comparison to known benchmark;
- set-up and dismantling of rover GPS antennae (i.e., affixing antennae to survey equipment), including necessary measurements; and
- confirmation that position data is being correctly logged in the instruments' data loggers.

5. References

Tierra Solutions, Inc. 2014. Quality Assurance Project Plan for River Mile 10.9 Pipeline Surveys: Geophysical Surveys: Parametric Echosounder and Ground Penetrating Radar. Revision 1. May.

APPENDIX B
Equipment Manuals

(*Provided Electronically*)